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Using Modelling Techniques to Analyze Urban Freight Distribution. A Case Study in Pamplona (Spain)

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Abstract

The city of Pamplona, in Spain, is currently experiencing several changes regarding sustainable mobility such as pedestrianization of some streets in the city center, and access control to the Old Town for motor vehicles through the use of automatic number-plate recognition. However, some groups including local neighbors and businesses are raising complaints as they are being affected by these measures. This is also the case for couriers and logistics companies which have now to comply with new regulations regarding delivery routes throughout the Old Town. This paper will present a comprehensive study of the situation that is being carried out, and in which social perceptions and freight traffic patterns in the Old Town of Pamplona are analyzed to understand how urban freight distribution could be improved in the area. For this purpose, we make use of a survey-based research to the stakeholders, i.e. pedestrians, logistics companies, retailers, and authorities of Pamplona. Results highlight pollution derived from transportation, lack of parking spaces as well as invasion of public spaces in the city center as the key issues for improving freight transportation in the Old Town. Finally, placing a distribution center in the Old Town and the promotion of the cycle-logistics are considered as the future of the urban distribution in Pamplona.

Keywords: mobility; sustainability; freight distribution; city logistics.

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1. Introduction

Old cities were not made for cars. Morphology of most of European city centers is based on an irregular matter that corresponded to an unplanned urban development. That irregularity as well as the abuse of the private vehicle as a means of transport has generated several mobility problems within the city (traffic jams, lack of parking spaces, noise and air pollution, lack of space for the pedestrian...) that makes life in cities increasingly unsustainable.

Many cities around the world have decided to improve the mobility of their citizens with the so-called 'sustainable urban mobility plans' (Fenton, 2017; Boisjoly and Yengoh, 2017), that are tools to improve the internal flows of the city (motorized or not) and which seek to cover the needs of citizens proposing alternative means of transport and/or infrastructures. However, this would mean a change in the actual status in the city center that not always reach total approbation due to several conflict of interest for the stakeholders such as users, retailers and logistics companies.

It is not only a mobility problem but also a health problem as emissions from vehicles have seriously increased air pollution in the cities. According to air quality indicator (EEA, 2017) carbon monoxide, lead, nitrogen dioxide, particulate matter, and sulfur dioxide values have skyrocket from 1980.

Examples of this phenomenon can be easily found in big cities such as Paris or Madrid (Slovic and Ribeiro, 2018; Prieto et al. 2017). In the former, there is a running plan to restrict and pedestrianize the city center in order to halve the number of private cars on the roads. While, in the latter, it is becoming increasingly often traffic restriction to park in the city center. And it is not only a problem affecting to the big cities, but also to the small and medium ones because in these the percentage of use of the private vehicle against the public transport is greater.

Freight distribution is one of the biggest actors playing in the city center that aggravate the saturated traffic situation. The increasing relevance of urban transportation is consequence of both, an increase of the population living in cities and an increase of e-commerce. Moreover, as freight urban transportation is mainly about distribution of goods to the last consumer, most deliveries are rather small, with many stops and attempts to meet the customer, which results in a noticeable increase of presence in the roads.

Application of sustainable urban mobility plans are not usually in line with interests of logistic companies. Higher restriction to access to the city center or to park to load or unload may compromise profitability of logistic companies that as their current delivery policies are not feasible anymore.

Literature about coexistence among the stakeholders in city centers is really scarce and it is mainly devoted to sustainability issues such as the case developed by Atakara and Akyay (2017). In their research, a survey is conducted for investigating the environmental, economic, and ecological problems because of the increasing importance of city centers. Similarly, Gedik and Yildis (2016) assessed the users' role in transforming the city center in an environmentally friendlier area. They found users' opinions have a big impact on authority's decision-making. Nevertheless, literature presents a gap in the role which transportation plays in urban distribution and its coexistence with pedestrians, retailers, and authorities. This article shows a picture on how urban transportation is working in the city center of Pamplona (Spain) by conducting a survey-based research to the stakeholders (pedestrians, logistics companies, retailers, and authorities). The surveys were administrated in a face-to-face and online ways, as well as formal interviews to the authorities of Pamplona. In total, we achieved a database of 540 surveys. Therefore, it can be showed how Pamplona is facing this city logistics problem and how it is possible to understand social perceptions from stakeholders towards new ways of delivering goods within the Old Town of Pamplona.

2. The case of Pamplona

Pamplona is a medium size city in Northern Spain having more than 190,000 inhabitants. The Old Town is known as one of the biggest in Spain, with more than 1 km2 and 10,000 inhabitants. It is also a very dynamic area where monuments, government offices, shops, bars and restaurants coexist. Moreover, the irregular morphology of their narrow streets make problematic the coexistence of pedestrians and vehicles.

Mobility of Pamplona is summarized in the Table 1 with data from Pamplona (Pamplona Municipal Council, 2017) with a comparison with Madrid (Madrid Municipal Council, 2014). As can be seen, trends have followed

inverse direction. While in Madrid transportation moving towards more sustainable modes such as walking (or cycling) and public transportation in detriment to the private car, Pamplona was doing the inverse path.

Table 1. Mobility distribution in Pamplona and Madrid

	Pamplona		Madrid	
	1996	2013	2004	2012
Waking + cycling	50%	47%	26%	29%
Public Transport	13%	12%	43%	42%
Cars	32%	36%	31%	29%
Others	5%	5%	-	-

In summer 2017, the sustainably urban mobility plan of Pamplona was adopted leading to many changes in the city center and in the surrounding areas. The details of the plan are described in numerous regulations that are accessible thought the webpage http://www.plandeamabilizacion.com, in Spanish. The goal of the plan is to reduce the use of private vehicles, prioritize sustainable means of transport such as walking and cycling, and give more relevance to the public transportation by bringing closer stops to the city center. In order to do this, the access to the city center has been restricted to non-authorized vehicles. For getting the authorization, vehicles must accomplish some requirements such as having a residence in the city center for the residents of providing a service in the city center for firms. In early October 2017, there were about 7,000 solicitors to gain access, of those, only 5,800 permits were granted, 2,200 of them were residents and 3,600 belong to companies.

The urban plan also consisted on the pedestrianization of many streets as well as the restriction of many others to public transports such as buses and taxis. Furthermore, more than 700 car parking spots have either disappeared or turned into only-residents ones, making the access to the city center by car pretty difficult.

With regard to the freight transportation, hard time windows have been applied: deliveries are only allowed between 8:00h and 11:00h, as well as from 14:00h to 16:30h. Additionally, the Old Town has been divided into 4 different areas that vehicles must follow in the sense if one enters through one, one ought to exit through the same one. The existence of the zoning system, designed by the authorities of Pamplona, is motivated by five arguments: (i) to guarantee the safe movement of pedestrians and cyclists within the Old Town; (ii) to allow an organized and peaceful access for all the citizens to the shops, households, cultural buildings, schools, public organisms and monumental areas; (iii) to stimulate the economy and the urban development of the area; (iv) to reduce the number of motor vehicles passing through the Old Town; and (v) to get a better urban quality in the area, reducing the visual impact and the emissions caused by motor vehicles. The Figure 1 shows the actual zoning system in the Old Town of Pamplona.

Figure 1. Zoning system in the Old Town of Pamplona

3. Methodology

The details of the methodology are going to be summarized in the following sentences. First of all, the data collection consisted on surveys and interviews carried out in November 2017. The Table 2 shows the number of data collected depending on the methodology, i.e. online surveys, face-to face survey, and personal interviews for the stakeholders. The online surveys was sent by Internet the 1st November 2017 using several distribution lists available in Pamplona such as the university and city associations. Those surveys included extra questions for identifying fake respondents. The survey was also directly sent to shops, restaurants, and bars (retailers), and logistic companies that operate in the city center through their webpages. Personal surveys were carried out to pedestrians that were walking in the Old Town in the second week of November (6th to 12th November 2017) in two shifts: from 11:00h to 12:00h and from 18:00h to 19:00h. There were also some face-to-face surveys to selected retailers and logistic companies that asked so in their mails. To those logistics companies that were extremely involved in the Old Town sustainability plan, an interview was asked instead.

Table 2. Data source for surveys and interviews

Stakeholder	Online survey	Personal survey	Interview	Total
Pedestrians	450	50	-	500
Retailers	15	5	-	20
Logistic Companies	10	-	5	15
Authorities	-	-	5	5
Total	485	55	10	540

The questionnaires included a number of questions related to general data as well as questions related to the mobility in the city and the freight distribution in the city center. Particularly, the survey consists of 25 questions, which last for about 10 minutes and it was divided into 3 parts. Firstly, identifying data in order to differentiate the users of the sample based on different groups (gender, age, socioeconomic status, and so on). Subsequently, general data is collected to gradually focus on the issue of the freight distribution in the Old Town. For this reason, surveyed people are first asked about issues such as sustainability or pedestrianization in general, to later move to a more specific topics such as the freight distribution in the Old Town or the cycle-logistics as a way of distributing goods. Secondly, a list of questions related to frequency of going to the Old Town, the mode of transport and the frequency used to travel through the city. Thirdly, questions related to sustainability have the objective of knowing how sustainable the respondent thinks mobility is. Moreover, additional data are obtained related to the importance that users give to different problems that may exist in the Old Town (pedestrianization, pollution, access control…). Finally, other data about the freight distribution in the Old Town are collected related to the importance that users give to the freight distribution, its sustainability, how this distribution should be carried out or the inconvenience caused by the traditional delivery vehicles. The questionnaire ends with an open question about urban freight distribution. Details on survey structure is given in the Table 3.

Table 3. Structure of the surveys

Number of questions	Time	Topic
7	1’	General information
4	2’	Mobility habits
3	3’	Perceptions on the Old Town
11	4’	Perceptions on the urban freight distribution

The results here presented consist on three groups of questions. Firstly, identifying the importance of several transportation problems (pollution, noise, lack of parking spaces, lack of cycling lines, lack of accessibility, lack of public transport, excessive access control, excessive traffic, excessive freight traffic, and lack of pedestrianization) from pedestrians, retailers, and logistics companies viewpoints. Secondly, the opinion of the pedestrians regarding allowing motorized vehicles in the Old Town. Thirdly, identifying the importance of freight transportation problems (excessive number of trucks, visual impact, accidents, urban space invasion, and excessive speed) again from pedestrians, retailers, and logistic companies’ viewpoints. For instance, for the evaluation of the importance of pollution as a transportation problem it was asked: *’how much importance do you give to the pollution emitted from*

vehicles in the Old Town of Pamplona?' and the answers consisted on marking in a 4-point scale ranging from "No importance" to "Very important". The remaining questions followed a similar pattern.

With respect to the interviews, authorities from local and regional government and logistic operators were chosen for a formal interview. In these interviews the experts were asked about various topics such as what they considered to be the main problem, the challenges they face and possible improvements and solutions. Finally, they were asked about their opinion about the cycle-logistics and how they see the promotion of these vehicles in the freight distribution in the Old Town of Pamplona.

4. Results

The sample consisted of 58% of women and 42% of men having an average age of 46 years old. Those distributions are in line with the population of Pamplona so the sample is representative.

The problem identification from the pedestrians, retailers and logistic companies are showed in the Figure 2. Air and noise pollution is the most important problem for the pedestrians whereas excessive freight traffic and the lack of pedestrianization remains as a marginal problem. Nevertheless, one consequence of the sustainable mobility planning is the Old Town saturation in the time windows so air and noise pollution will be noticeable higher in those moments and much lower the rest of the day. At the same time, pedestrianization does not seem to be a priority for the pedestrians but essential for the authorities. It is remarkable retailers consider that lack of accessibility is the biggest problem. Actually, they have publish internal surveys highlighting a noticeable loss of sales due to the urban mobility plan.

Regarding the controversial issue of not allowing to enter motorized vehicles with exceptions, it seems that pedestrians are mainly agree, however, it is remarkable the 27% of those that prefer to remove the exceptions as can be seen in the Figure 3.

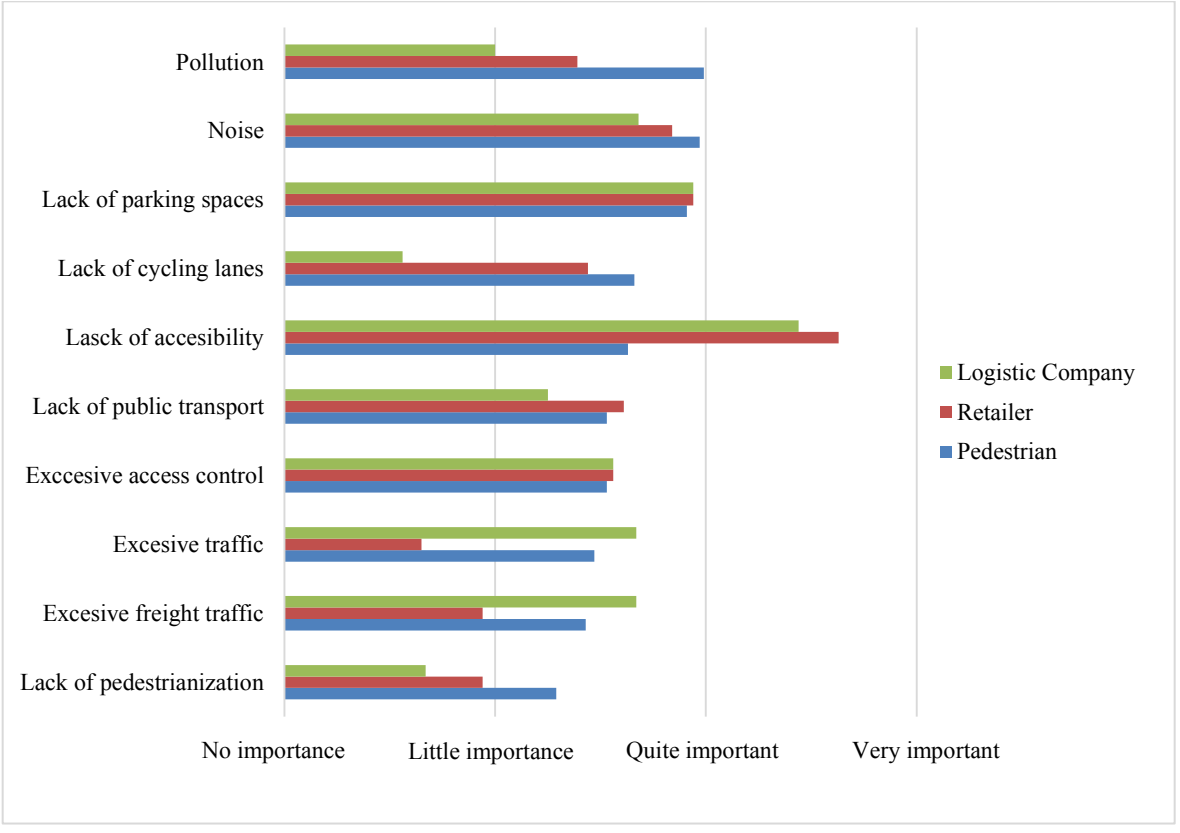

Figure 2. Transportation problem identifications by stakeholders

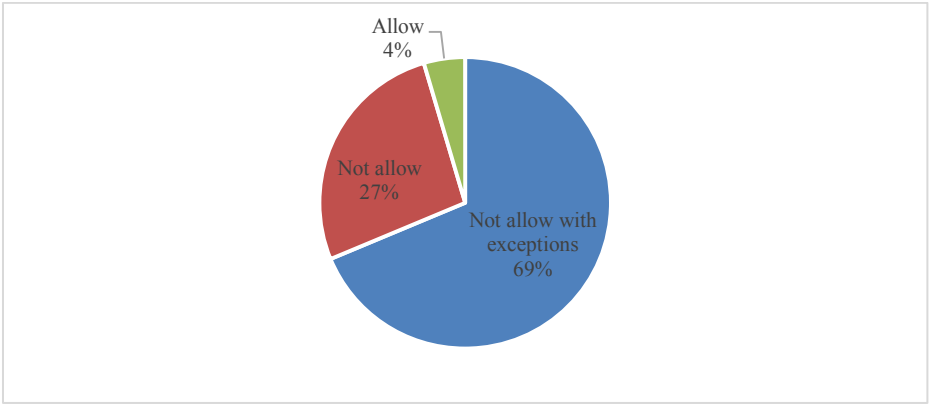

Figure 3. Allowing to access to the Old Town with motorized vehicles. Data from pedestrians.

Focusing on the freight distribution, space invasion of trucks is the biggest problem for the pedestrians, whereas visual impacts is for the retailers. Accidents is a major issue for the logistics operators. The entire information is showed in the Figure 4.

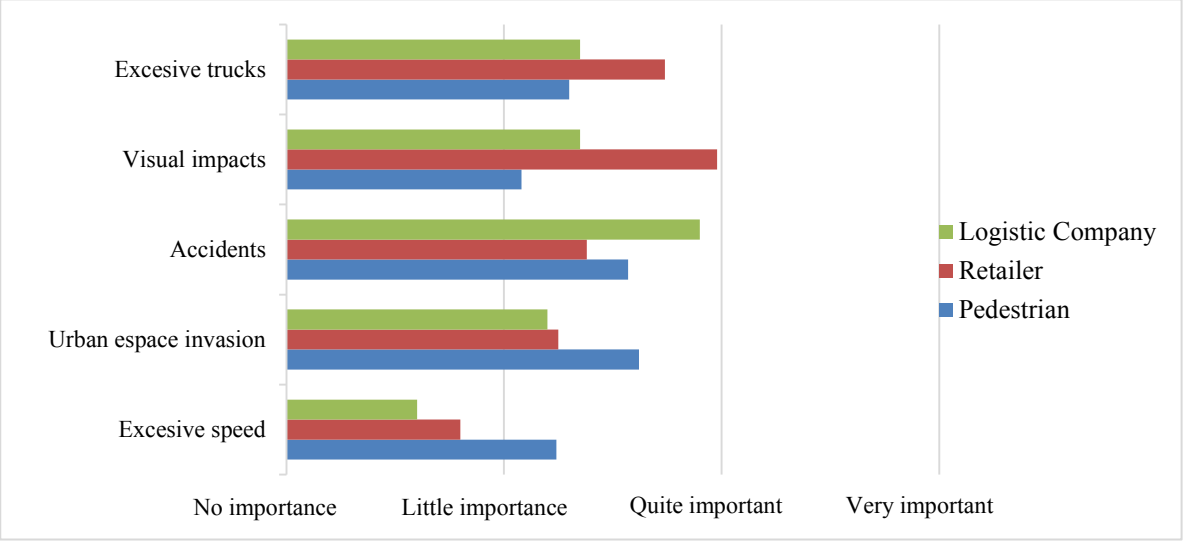

Figure 4. Freight transportation problem identifications by stakeholders

The experts and authorities list some ways of improving the freight transportation in the Old Town. Those suggestions include an increase of non-polluting vehicles, such as electric vehicles and cargo-bikes. Additionally, the creation of a consolidation center in the city center is seen as an efficient way of reducing the vehicles.

5. Conclusions

The city of Pamplona is experiencing a lot of changes related to sustainable mobility as an urban sustainable mobility plan has recently been applied, mainly affecting freight distribution in the Old Town. Shops, restaurants, pedestrians, and people living in that area are complaining as the excessive access control to the Old Town is disturbing the livability of the Old Town, and also a decrease in sales has been perceived. For that reason, this study aims to understand what the social perceptions of the people of Pamplona are regarding freight distribution in the Old Town.

Results suggest freight transportation is of great importance for the stakeholders. In addition, freight transportation generate a number of drawbacks to users such as pollution, limited parking slots, invasion of public space, and accidents. Firstly, the new concern regarding the environment is placing its focus on environmentally friendlier modes of transportation and it is reflected in the results of our survey, being the pollution the largest problem in the city center of Pamplona. Controversially, difficulties for finding parking slots are also of highest importance. This situation is due to the fact that Pamplona is a medium size city having necessity of improving its public transportation network. Thirdly, as the Old Town of Pamplona is one the most dynamic points in the city where plenty of activities meet every day at every time, the invasion of their streets by vehicles is also considered as a huge problem. Finally, the accidents, as a consequence of the previous lines, are a barrier for more important social development in the city center. For all this, pedestrians, logistic companies, retailers and experts in the field believe that measures should be taken in the future. A distribution center nearby the city center as well as the use of cargo-bikes is seen as a good alternative to mitigate both environmental and social effects of the saturated cite center.

Finally, promising additional research can be made on this direction. Firstly, a comparison of social perception can be performed between different cities in order to obtain key indicators. Secondly, a quantitative model is planned to be developed using the automatic number plate recognition system, similarly to the work developed by Zheng et al. (2017). This would allow to measure the phenomenon with real-time data. Finally, current research trends are in line with the optimization of the logistics operations. For instance, solving the vehicle routing problems with environmental criteria (Lin et al. 2014), or the environmentally friendlier facility location problem (Harris et al., 2014). To this respect, availability and quality of the data obtained would be of utmost interest.

Acknowledgments

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